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Maximum efficiency of the collisional Penrose process

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Abstract

© 2016 American Physical Society.We consider the collision of two particles that move in the equatorial plane near a general stationary rotating axially symmetric extremal black hole. One of the particles is critical (with fine-tuned parameters) and moves in the outward direction. The second particle (usual, not fine-tuned) comes from infinity. We examine the efficiency η of the collisional Penrose process. There are two relevant cases here: a particle falling into a black hole after collision (i) is heavy or (ii) has a finite mass. We show that the maximum of η in case (ii) is less than or equal to that in case (i). It is argued that for superheavy particles, the bound applies to nonequatorial motion as well. As an example, we analyze collision in the Kerr-Newman background. When the bound is the same for processes (i) and (ii), η=3 for this metric. For the Kerr black hole, recent results in the literature are reproduced.

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